Opening a window on the ionised interstellar medium of nearby galaxies

Research Field
Radio Astronomy

Project Suitability
PhD
Honours

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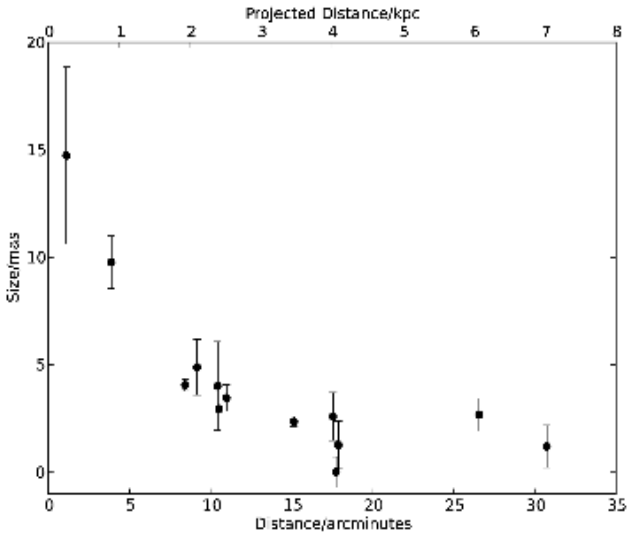
The ionised Interstellar Medium (ISM) is an important component of our Galaxy, comprising as much as 50% by volume and 80% by mass of the total ISM. It traces many astrophysical processes, and yet, due to the difficulty of observing it directly (compared with the neutral component, which can be studied via the 21 cm line) it is poorly understood. Very Long Baseline Interferometry (VLBI) observations allow the turbulence in the ionised ISM to be probed along lines of sight by measuring the "scatter broadening'" of intrinsically compact sources. However, there are great difficulties in determining the distribution of the ionised ISM from our position well within the plane: only within 1kpc of the Solar System can complex structure be mapped, allowing correlation with other astrophysical phenomena.

Applying this technique to other galaxies could produce significantly improved results since even a small inclination to the line of sight separates the components of the ISM, greatly increasing the observable information. A pilot study of M31 undertaken a few of years ago showed very promising results, with strong evidence of the detection of the ionoised ISM of a nearby galaxy for the first time. Much deeper VLBI observations of M31 have now been undertaken and await analysis.

Beyond the main goal measuring the ISM of M31 there are further secondary goals that might be achieved with these data. The first is HI absorption towards the brighter background sources, one of which lies right on a neutral filament in the M31 galaxy. The second is determining accurately the brightness M31* across at least 3 epochs in 2012, when it is thought to be much dimmer than expected. Third, the possibility of detecting compact sources that are hosted within M31, such as X-ray binaries.



With future instruments, such as the SKA participating in observations, the number of lines of sight probing a galaxy such as M31 would be enormous. Planning for such observations could also form part of the project if the student is interested.

Fig: The angular size of sources (assumed to be intrinsically compact sources seen through the M31 galaxy as a function of angular distance from the core of M31. Those nearest to the centre appear to be larger. This is thought to be due to "scatter broadening" of the sources by the turbulent ISM of M31.